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Targeting Inflation from Below—How Do Inflation Expectations Behave?

by Michael Ehrmann

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Abstract

Inflation targeting (IT) had originally been introduced as a device to bring inflation down and stabilize it at low levels. Given the current environment of persistently weak inflation in many advanced economies, IT central banks must now bring inflation up to target. In this paper, the author tests to what extent inflation expectations are anchored in such circumstances, by comparing (i) IT and non-IT countries, and (ii) across periods when inflation is at normal levels, (persistently) high, or (persistently) weak. He finds that under low and persistently low inflation, some disanchoring can occur—inflation expectations are more dependent on lagged inflation; forecasters tend to disagree more; and inflation expectations get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. Since inflation expectations in IT countries are substantially better anchored than those in the control group, policy rates in IT countries need to react less to changes in inflation, making IT central banks considerably less likely to hit the zero lower bound.

JEL classification: E52, E58, E31, C53
Bank classification: Inflation and prices; Inflation targets

Résumé

Les régimes de ciblage de l'inflation ont été proposés au départ comme moyen de faire baisser l'inflation et de la maintenir à des niveaux bas. Or dans le contexte actuel caractérisé par la faiblesse persistante de l'inflation dans de nombreux pays avancés, l'action des banques centrales qui poursuivent une cible d'inflation se porte maintenant sur la remontée de l'inflation à la cible fixée. Dans son étude, l'auteur détermine à l'aide de tests jusqu'à quel point les attentes d'inflation restent ancrées à la cible en de telles circonstances en comparant les pays qui ont adopté une cible d'inflation à des pays qui n'ont pas retenu cette stratégie, d'une part, et, d'autre part, en comparant ces attentes respectives en périodes d'inflation normale, (durablement) élevée ou (durablement) basse. Il constate qu'en période d'inflation faible et durablement faible un certain désancrage peut se produire – à savoir que les attentes d'inflation affichent une dépendance accrue à l'égard du taux d'inflation passé, que les prévisionnistes sont davantage en désaccord et que les anticipations sont révisées à la baisse lorsque l'inflation se révèle plus faible qu'escompté, mais ne réagissent pas dans le cas contraire. Les anticipations d'inflation sont nettement mieux ancrées dans les pays où l'on poursuit une cible d'inflation que dans le groupe témoin. Il n'est donc pas nécessaire que le taux directeur varie autant en réaction à une évolution de l'inflation, et les banques centrales de ces pays sont beaucoup moins susceptibles de se heurter à la borne du zéro.

Classification JEL : E52, E58, E31, C53
Classification de la Banque : Inflation et prix; Cibles d'inflation

1. Introduction

When inflation targeting (IT) was first introduced in New Zealand in 1989, its aim was to reduce and stabilize inflation, and to anchor inflation expectations at lower levels, given that inflation had been running at double-digit rates for much of the late 1970s and the 1980s. Subsequent adopters of IT, such as Canada in 1991 or the United Kingdom in 1992, also intended to bring inflation down, to make it less volatile, and to anchor inflation expectations at a lower level.

In contrast, more recently, the Bank of Japan adopted IT following an extended period of subdued inflation, with the declared intention to bring inflation up to target and to boost inflation expectations. In a similar vein, in 2012, the U.S. Federal Reserve announced an inflation goal in a situation where headline inflation stood slightly above the new goal, but core inflation had been substantially below for a considerable amount of time. Also, following the global financial crisis, a number of countries that had already adopted IT were (and, at the time of writing, several of them still are) faced with a prolonged period of below-target inflation.

Although designed to *lower* inflation and inflation expectations, IT is now charged with the objective to *raise* them, a challenge that has not yet been studied extensively.[1] It is therefore important to provide evidence on the actual behaviour of inflation, inflation expectations and policy rates in the presence of weak inflation. Questions that are of particular interest in such an environment are whether the formation of inflation expectations differs when inflation is (persistently) weak from when inflation is at or above target, whether there is a risk that inflation expectations become disanchored, and whether the possibility of hitting the zero lower bound (ZLB) will affect the speed at which inflation can be brought back to target.

[1] At the same time, there is an ongoing debate about the optimal level of inflation targets under low inflation. Several authors (Blanchard, Dell'Ariccia and Mauro 2010; Ball 2014) have proposed raising inflation targets from the currently common level of around 2% to a new level of 4%, in order to reduce the likelihood of hitting the zero lower bound (ZLB). The question has been discussed critically, for instance, by McCallum (2011), Walsh (2011), and Coibion, Gorodnichenko and Wieland (2012), but has generally been met with resistance by central bankers (e.g., Bernanke 2010).

Naturally, given the historical background of IT, the existing literature has mostly studied the performance of IT in bringing inflation down, stabilizing it and anchoring inflation expectations. In contrast, much less is known about how IT performs if inflation is below target, and persistently so.

Since we have recently seen low inflation for prolonged periods in a number of advanced economies, sufficient amounts of data have accrued that now allow us to provide some empirical evidence that can address these questions. This paper studies to what extent inflation expectations are anchored in different inflation regimes—in normal times, under high (and possibly persistently high) inflation, and if inflation is weak (and persistently so). It employs monthly inflation expectations as provided by Consensus Economics for 15 countries, covering the time between January 1990 and May 2014. Based on these data, the paper tests (i) the extent to which inflation expectations depend on lagged, realized inflation, (ii) the extent to which forecasters disagree, and (iii) how inflation expectations are revised in response to news about inflation. In addition to studying the differences across the various inflation regimes, the paper also compares IT countries with a control group.

There are two key findings. First, under low and persistently low inflation, some disanchoring of inflation expectations occurs. Evidence for this comes from all three tests: inflation expectations are more dependent on lagged inflation; forecasters tend to disagree more; and inflation expectations get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. This evidence suggests that central banks, even those with an inflation target, should expect inflation expectations to return to target (or the historical mean) more slowly in an environment of weak inflation.

Second, inflation expectations in IT countries are substantially better anchored than those in the control group. With better-anchored inflation expectations, policy rates need to react less to changes in inflation. In fact, the paper shows that under IT, policy rates co-move less with inflation, such that even when inflation is weak, or persistently weak, IT central banks are considerably less likely to hit the ZLB. This is consistent with the prediction of a simple Taylor-rule model—if the central bank threatens to be more aggressive on inflation, it will

have to move policy rates by less in equilibrium. While this finding does not inform the debate on the optimal level of the inflation target, it clearly demonstrates the importance of pinning down inflation expectations by providing a quantitative anchor.

The paper proceeds as follows: Section 2 provides an overview of the related literature. The data are explained in Section 3. The current environment of weak inflation in advanced economies is discussed in Section 4. Section 5 presents the empirical evidence regarding the behaviour of inflation expectations, and Section 6 discusses the implications for policy rates. Section 7 concludes.

2. Literature review

There is a large empirical literature on the effects of IT. Since IT had been designed with a view to taming inflation and inflation expectations, this has been the focus of most previous contributions. The two main aspects of this literature are (i) the effect on inflation and (ii) the effect on inflation expectations. We will briefly review each (for a more detailed summary of the relevant literature and its placement in the broader context of central bank communication, see Blinder et al. (2008)).

The effect on inflation

Despite the fact that IT is viewed as a success by IT central banks, and even though inflation has typically been lower and more stable following the adoption of inflation targets, there is still a vigorous debate on the merits of IT. There has been early supportive evidence (King (2002) for the United Kingdom, and Kuttner and Posen (1999) for Canada and the United Kingdom), and Bleich, Fendel and Rülke (2012) show that the introduction of IT has significantly shifted the reaction functions of central banks toward inflation stabilization. Still, others have questioned whether there is a causal link between IT and inflation developments, pointing to various complications in any empirical analysis of this question.

One complication is a possible endogeneity issue, whereby countries that adopted IT often had above-average inflation prior to adoption. Ball and Sheridan (2005) argue that this

affects the empirical evidence, showing that once mean reversion in inflation is allowed for by controlling for the initial level of inflation, the decline in inflation is similar for targeters and non-targeters—a result that is shared by Willard (2012).

Another complication is the identification of a control group. Mishkin and Schmidt-Hebbel (2007), for instance, argue that inflation targeters do not show a superior performance than that of a group of successful non-targeters. Still, even when using advanced econometric methodologies such as propensity score matching to address this issue, the evidence remains inconclusive: Vega and Winkelried (2005) conclude that IT has had the desired effect, whereas Lin and Ye (2007) come to the opposite conclusion.[2]

One reason for the inconclusive findings could be that several countries in the usual control group have adopted other forms of quantitative targets. Fatas, Mihov and Rose (2007) argue that the quantification matters more than the type of the target, since they find that inflation, exchange rate and monetary targets are linked to lower inflation. Also, IT might be more successful under some circumstances—Alpanda and Honig (2014) find little evidence for the success of IT overall, but identify substantial effects of IT in emerging economies with low central bank independence.

The effect on inflation expectations

The evidence regarding the effect of IT on inflation expectations is inconclusive. Johnson (2003) predicts expected inflation in IT countries based on a model of expectation determination prior to the adoption of IT, and finds that actual inflation expectations are substantially lower than their predicted values. Comparing targeting with non-targeting countries, Johnson (2002) provides evidence of a relative reduction in inflation expectations in the IT countries, while Levin, Natalucci and Piger (2004) show that long-term inflation forecasts depend on past inflation in the control group, but not in the IT group. Gürkaynak, Levin and Swanson (2010) and Davis (2014) find inflation expectations to be less responsive to news in IT countries than in the respective control groups.

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[2] Other complications arise because the start of IT needs to be defined (for instance, as the announcement date, as in Bernanke, Laubach, Mishkin and Posen (1999), or as the implementation date, as in Ball and Sheridan (2005)), and because the classification of inflation targeters is not always clear (Kuttner 2004).

While these studies suggest a better anchoring of inflation expectations in IT countries, other evidence does not confirm these findings. Castelnuovo, Nicoletti-Altimari and Rodriguez-Palenzuela (2003) find that long-term inflation expectations are well-anchored in all countries in their sample except Japan, regardless of whether the central bank has an inflation target or not. Also, Pierdzioch and Rülke (2013) show that forecasters in IT countries often scatter their inflation forecasts away from the inflation target.

Another strand of this literature has studied the effects of IT, or central bank transparency more generally, on *disagreement* among inflation forecasters. Capistran and Timmermann (2009) show that disagreement in inflation expectations rises with the level and the variance of the inflation rate, such that we might expect less disagreement under IT (if having an inflation target contributes to reducing and stabilizing inflation). Swanson (2006) finds that with the increased transparency of the U.S. Federal Reserve, the dispersion across private sector forecasters of U.S. interest rates has declined, a finding that is supported at the international level in Dovern, Fritsche and Slacalek (2012). Crowe (2010) tests whether IT promotes convergence to lower forecast errors, and points out that convergence occurs in all countries because of mean reversion, but that the adoption of IT leads to greater convergence. Ehrmann, Eijffinger and Fratzscher (2012) identify IT as one of various transparency measures that effectively reduce disagreement among inflation forecasters

Other evidence is less conclusive. Cecchetti and Hakkio (2010) report only small effects, and Capistran and Ramos-Francia (2010) detect them only for developing countries. Siklos (2013) studies forecaster disagreement across many different forecast types, including those prepared by central banks and international institutions, as well as survey-based forecasts conducted among households and businesses. He finds that central bank transparency in general is associated with an *increase* in forecast disagreement, but that the adoption of IT has little effect on forecast disagreement.

To summarize, it appears that the case for IT is far from settled. Most longitudinal analyses find that inflation is reduced and more stable, and that inflation expectations fall and are better anchored after the adoption of an inflation target, whereas cross-sectional

comparisons often conclude that similar results have also been obtained in other countries. In other words, it appears that while IT has lived up to its promise, it is not unique in delivering low and stable inflation and well-anchored inflation expectations.

Similar to the existing literature, this paper compares IT central banks with non-targeters. At the same time, it adds a new dimension to the analysis by studying the performance of IT in different circumstances, namely when inflation is weak (and persistently so), as opposed to times when inflation is at a normal level, or when inflation is high (and persistently so).

3. Data

For the empirical analysis, we use data on inflation expectations provided by Consensus Economics, which are based on surveys among professional forecasters, and are available for a reasonably long history in a comparable fashion across countries. The same database has been used in several related studies, such as Crowe (2010), Davis (2014), Dovern, Fritsche and Slacalek (2012), and Ehrmann, Eijffinger and Fratzscher (2012).

Since the recent episode of weak inflation has been largely an advanced-economy phenomenon, we restrict the analysis to the advanced economies in the data set. Also, since we are, *inter alia*, interested in studying forecaster disagreement, the set of countries is restricted to those where individual forecaster data are available. Accordingly, the data set spans the following economies: Australia, Canada, the euro area, France, Germany, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom and the United States. The data are monthly, and the mean inflation forecasts start in January 1990 (with the exception of the euro area, for which forecasts start in December 2002). Table 1 provides information on the data availability by country and shows that the individual forecaster data are available somewhat later for some countries.

The sample ends in May 2014. Note, however, that we end the sample for all euro area countries in December 1998, i.e., with the formation of the monetary union. The reason for this is that there are no country-specific inflation targets—the European Central Bank

(ECB) defines price stability for the euro area as a whole, and because of relatively persistent inflation differentials across the euro area countries (Angeloni and Ehrmann 2007), it is not clear how the euro area objective would translate into national inflation expectations. This procedure also ensures that the euro area is not included several times once data for the euro area aggregate are available.

Table 1 here

On average, the data set comprises 20 forecasters per country and month, but there is some variation, with a minimum of 6 and a maximum of 52 respondents. Survey participation is relatively smaller in the Netherlands and Norway, with 9 forecasters on average; whereas the number of forecasters in the euro area, Germany, Japan, the United Kingdom and the United States is relatively large, with more than 25 on average.

In the Consensus Economics survey, respondents are asked to provide their forecasts for consumer price inflation (per cent change per annum) for the current and the next calendar year. This implies that the forecast horizon decreases over the course of a given year—although a current-calendar-year forecast in January spans nearly an entire year, the forecasting problem in December is much simpler, since much of the year's data are already realized and released. In the empirical analysis, we will therefore control for the forecast horizon by including month fixed effects.

These are the data used in the core analysis of this paper, but we also use other, related, data provided by Consensus Economics. First, we study the forecasts of real GDP growth and of 3-month and 10-year interest rates. Second, twice a year, in April and October, the Consensus survey contains additional long-term forecasts with horizons covering each calendar year up to 10 years out. Unfortunately, since the individual forecasts are not provided by Consensus Economics, we can rely only on the mean forecast.

We sourced the actual consumer price inflation rates from the national statistical offices via Haver Analytics.[3] The central bank policy rates were taken from central bank websites, as were the levels of the central banks' inflation targets, if applicable.[4]

Since we are interested in the effects of IT, it is essential to classify countries accordingly. Beyond the set of central banks that are officially classified as inflation targeters, we also include the current monetary policy regimes of the Federal Reserve, the Swiss National Bank and the ECB in the IT category. These central banks currently have a quantified inflation objective—while they are not inflation targeters *sensu stricto*, the quantification of the inflation objective should provide a similar anchor for inflation expectations. We construct a dummy variable, with the value of one representing the month when the quantified inflation objective was adopted (as in Ball and Sheridan (2005)), according to the central bank websites. Alternatives would have been the announcement date (as in Bernanke, Laubach, Mishkin and Posen (1999)), or a later date to allow that central banks need to build up credibility for their target (e.g., Goldberg and Klein (2011) for the ECB). Choosing the adoption date places us in the middle of these alternatives. As shown in Table 1, all countries are classified as inflation targeters at the very end of our sample, given that the Federal Reserve and the Bank of Japan also adopted quantified objectives in early 2012.[5]

Table 2 provides some information on how the inflation outcomes under IT compare with those of the non-targeting central banks in our sample. A number of points are noteworthy. First, the numbers of IT and non-IT observations are reasonably similar: there are around 1,800 observations under IT, compared with around 1,300 for the control group. Second, the level of inflation has also been quite similar in both groups—under IT, inflation has

[3] We use consumer price index (CPI) inflation rates for all countries, in line with the concept that is forecasted in the Consensus Economics survey, even if the inflation target relates to a different price concept (such as the Harmonised Index of Consumer Prices (HICP) in the euro area). Results are robust to using the alternative inflation concept.

[4] Unfortunately, variation in the inflation targets is only very small (they range from 1% to 3%, with 61% of all observations corresponding to a target of 2%, and another 32% of observations to a target of 2.5%), preventing us from testing whether relatively higher targets attenuate the findings that inflation expectations are not anchored as well under low inflation.

[5] Previously, the Bank of Japan had stated that it would maintain its zero-interest-rate policy until it identified a sustained period of "price stability," which many believed the Bank saw at 0%. In February 2012, it announced an explicit inflation goal (of 1%, changed to 2% in January 2013).

been somewhat lower at an average of 1.9%, compared with an average of 2.2% in the control group. Third, inflation has been more stable under IT, as can be seen both by the lower standard deviation and the fact that the extreme outcomes are less severe (in particular, at the upper end, where the maximum observed inflation rate in the control group is, at 12.6%, substantially above the maximum observation in the IT group, at 6.1%). Fourth, inflation has also been somewhat less persistent in the IT group, as shown by the lower autoregressive coefficient. Overall, however, it is fair to argue that the two groups are reasonably similar in terms of their inflation outcomes, illustrating that a comparison across these two groups is a meaningful exercise. In addition, one difference that needs mentioning is that the two groups are partially observed at different points in time—as already mentioned, at the very end of the sample, all central banks are classified as IT, which implies that there are relatively more observations for the control group in the earlier parts of the sample. The fact that central bank practices might have changed over time for IT and non-IT central banks alike (such as the way central banks communicate to the public, e.g., by using forward guidance) complicates the comparison.

Tables 2 and 3 here

Table 3 shows whether the differences in inflation performance also translate into different inflation expectations, for both the current-calendar-year and the next-calendar-year forecasts. In line with the results for actual inflation, we find that inflation expectations are somewhat lower, considerably more stable and spread within a smaller range in the IT countries.

Finally, we test the extent to which inflation expectations respond to news about realized inflation. For that purpose, we follow the standard in the announcement literature (e.g., Andersen et al. (2003)) and calculate the surprise component contained in the release of CPI inflation by deducting the expectation of the announcement from the actual announcement value. As is common in this literature, we have obtained data on the expectations of the macroeconomic releases from a survey among financial market participants conducted by Bloomberg, and we use the median response as our measure of expectations. We ensure that the data release is appropriately assigned to the relevant

Consensus Economics forecast round; i.e., we test whether the inflation forecasts respond to the data release that occurs just before the survey is conducted.

4. The current environment of weak inflation in advanced economies

Following the global financial crisis, inflation developments in advanced economies have surprised many economists, in two different ways. First, as documented by the International Monetary Fund (2013), there has been a period of "missing disinflation": based on previous relationships, given the depth of the recession, inflation should have declined much more strongly than it actually did. This period has been analyzed, *inter alia*, by Coibion and Gorodnichenko (2015), Del Negro, Giannoni and Schorfheide (2014), Gordon (2013), and Murphy (2014).

Second, inflation has more recently surprised to the downside. While policy-makers have pointed this out (e.g., Macklem 2014), little research has tried to understand the drivers of inflation dynamics in this period, with the notable exceptions of Ferroni and Mojon (2014) and Friedrich (2014).

Figure 1 here

Figure 1 provides some evidence that the developments in advanced economies' inflation rates in 2013 were indeed surprising to economists. Panel A shows how the 2013 calendar-year forecasts gathered by Consensus Economics were revised over the course of 2013 (by comparing the mean forecasts for a given country c provided in January with those provided in December 2013: $E_{c,December2013}(\pi_{c,2013}) - E_{c,January2013}(\pi_{c,2013})$). In most countries, inflation forecasts were revised downward, and in many cases substantially so. To check this finding, Panel B shows the corresponding revisions to GDP growth forecasts (ordered as in panel A, i.e., by the magnitude of the revision in inflation forecasts). While inflation forecasts were consistently revised down over the course of the year, this is not true for GDP growth forecasts, confirming that inflation forecasts were not revised down as

a consequence of downward revisions to economic activity.[6] Rather, the evolution of inflation itself seems to have surprised forecasters.

Overall, the period following the global financial crisis can be characterized as one of weak inflation. This is illustrated in Panel A of Figure 2, which shows the number of months that inflation has been below target since 2009 in the various countries. This was the case for 70% of all observations (79% since 2012). The most extreme cases are Switzerland and Japan, where inflation has been below the definition of price stability in 65 and 63 out of the 65 months in that period, respectively. On the other side of the spectrum is the United Kingdom, with only 11 out of 65 months with below-target inflation. Furthermore, inflation has been below target by substantial amounts. The average gap between inflation and its target has been -0.7 percentage points since 2009, and -0.9 percentage points since 2012.

Not only has inflation been low on average, it has also been low in a persistent manner. This is illustrated in Panel B of Figure 2, which shows the maximum number of consecutive months for which inflation has been below target since 2009 in each country. Obviously, the outliers are again Switzerland and Japan, with inflation below the objective in 65 and 63 out of the 65 months, respectively, but many other countries have also seen persistently weak inflation, with New Zealand, Norway and Sweden all having had 30 or more consecutive months with inflation below target.

Figure 2 here

At the end of the sample, inflation was below target in 12 of the 15 countries, suggesting that the episode of weak inflation is still ongoing at the time of writing this paper. With the number of instances of inflation below target, by relevant amounts and for long, it is now possible to test the hypotheses of this paper empirically.

[6] Looking at the evolution of oil prices or the Consensus Economics oil price forecasts, it is clear that the downward revisions to inflation expectations were not driven by oil prices, either.

5. The anchoring of inflation expectations

The first hypothesis to be studied in this paper is the extent to which inflation expectations are anchored, comparing (i) the IT countries with the control group, and (ii) different inflation environments within each group of countries. We will perform three types of tests for the anchoring of expectations. The first examines the extent to which inflation expectations depend on lagged, realized inflation; the second studies disagreement across forecasters; and the third tests the extent to which inflation expectations get revised in response to inflation news.

Dependence on realized inflation

If inflation expectations were perfectly anchored at target, they should not move away from the target, regardless of the current inflation rate that is observed in the economy. Such a degree of anchoring is most likely not observed in the data, but the example clarifies that a valid test for the anchoring of inflation expectations is the degree to which they depend on the inflation rates that are observed in the economy. This type of test has a long tradition in the related literature and has, for instance, been employed in Levin, Natalucci and Piger (2004).

It is typically assumed that central banks can affect inflation only after several months, because of lags in the transmission mechanism of monetary policy. Accordingly, we should expect that inflation expectations depend more on realized inflation for shorter forecasting horizons than for longer horizons. To test for this hypothesis, we employ the semi-annual long-term forecasts that are provided by Consensus Economics, and run the following regression:

$$E_{c,t}(\pi_{c,t+h}) = \alpha_c + \alpha_m + \beta_1 \pi_{c,t-1} + \beta_2 IT_{c,t} + \beta_3 IT_{c,t} \pi_{c,t-1} + \varepsilon_{c,t}, \qquad (1)$$

where $E_{c,t}(\pi_{c,t+h})$ denotes the mean inflation expectations for country c over the forecast horizon h, collected in the Consensus Economics survey conducted in month t. α_c and α_m

are country and month fixed effects,[7] and $IT_{c,t}$ is a dummy variable for inflation targeters. The models are estimated by ordinary least squares. We allow for panel-corrected standard errors, which take into account possible heteroskedasticity within countries and correlation across countries.

Figure 3 provides the results of this test for the forecast horizon *h*, ranging from the next calendar year to 10 calendar years out. It shows the coefficients β_1, which portray the situation in the control group, as well as $\beta_1 + \beta_3$, which inform us about the anchoring of inflation expectations in the IT countries. To gauge the statistical significance of the estimates, the chart shows two standard-deviation error bands as dashed lines.

Figure 3 here

A number of results emerge. First, inflation expectations are somewhat backward-looking, even at very long horizons, and for both country groups. Second, as expected, the dependence on realized inflation is substantially larger for shorter horizons.[8] Third, inflation expectations in the IT countries are better anchored at all forecast horizons, but especially so at the short end, where the gap is particularly substantial.

A limitation of these long-term inflation expectations is that they are available only twice a year, yielding few observations to test more-refined hypotheses. When distinguishing across periods of high and low inflation, we therefore use the monthly survey data, and focus on the next-calendar-year forecasts. The regression specification of these tests is as follows:

$$E_{c,t}(\pi_{c,t+h1}) = \alpha_c + \alpha_m + \beta_1 \pi_{c,t-1} + \beta_2 D^l_{c,t} + \beta_3 D^l_{c,t} \pi_{c,t-1} + \beta_4 D^h_{c,t} + \beta_5 D^h_{c,t} \pi_{c,t-1} + \varepsilon_{c,t}, \quad (2)$$

[7] The month fixed effects control for the changing forecasting horizon in the Consensus Economics survey. The country fixed effects control for possible country-specific differences that can affect inflation expectations, such as the quality of the forecaster pool, the difficulty in forecasting in a given economy (e.g., because smaller economies are more prone to shocks and, as such, might *ceteris paribus* be relatively more volatile). Note that the inclusion of country fixed effects implies that any effect of IT on the estimated relationships arises entirely because of the adoption of IT within countries over time. We look into the importance of this issue in the robustness tests.

[8] For a formal test of the anchoring of inflation expectations that exploits this property, see Mehrotra and Yetman (2014).

where $h1$ denotes the forecast horizon for the next-calendar-year forecasts, $D_{c,t}^{l}$ is a dummy variable for times of (persistently) low inflation, and $D_{c,t}^{h}$ is a dummy variable for periods when inflation is (persistently) high. In this specification, we no longer estimate separate coefficients for IT and non-IT countries. Rather, we estimate equation (2) twice, once for the IT group, and once for the control group. While this does not allow for testing whether the coefficients are statistically significantly different across groups, it avoids the inclusion of triple interaction terms.

The corresponding results are provided in Table 4. The first two columns report results from a regression that does not differentiate across different inflation episodes. It is apparent that the monthly data show a very similar relationship to that of the semi-annual forecasts in Figure 3 (the relevant comparison being the coefficients shown at the very left end of Figure 3), with inflation expectations substantially better anchored in the IT group.

Table 4 here

In the subsequent estimations, we distinguish different inflation episodes. First, we test periods of low and high inflation. For the IT countries, these are defined as times when inflation is more than 1 percentage point below target, and more than 1 percentage point above target, respectively. For the control group, in the absence of an inflation target, we consider inflation to be low whenever it is below 1%, and to be high whenever it is above 3%. This choice implies that, first, the width of the band for "normal" inflation is identical for both groups and, second, the mid-point for this band is close to the historical mean that is observed in our sample period, for both IT countries (where the mean is 1.9%) and the control group (with a mean of 2.2%).[9]

Second, to test for different effects if inflation is high or low in a persistent manner, we define a dummy variable that is equal to one if inflation has been low (or high) according to the above definition for at least six consecutive months. Finally, a third variable is defined if inflation has been low (high) for even longer, namely for at least nine consecutive months. We call these episodes times of very persistently low (or high) inflation.

[9] All results are also robust for the IT group when we define low and high inflation to be below 1% and above 3%, respectively. Results are available from the author upon request.

The underlying hypothesis is that the determination of inflation expectations might be affected if inflation is low (high) for long. This notion is consistent with recent work by Bianchi and Melosi (2013), who develop a theoretical framework in which the anti-inflationary determination of monetary policy varies over time. In this context, inflation expectations remain anchored when the central bank deviates from an active monetary policy for a short period of time, but disanchoring occurs and uncertainty rises when the deviation persists over time.

The first row in Table 4 shows the dependence on lagged inflation that results in times when inflation is neither (persistently) low nor (persistently) high. The estimated coefficients are similar to those obtained for the full sample (shown in columns (1) and (2)), and are substantially smaller for the IT countries than for the control group.

There is little evidence that the behaviour of inflation expectations changes if inflation is *high*, or persistently so. In contrast, the results suggest that if inflation is *low*, and in particular if it is low for long, inflation expectations become more dependent on realized inflation. The magnitudes are substantial—if inflation has been low for at least nine consecutive months, the overall coefficient (given as the sum of $\beta_1 + \beta_3$) is 0.340 for IT countries, compared with a coefficient of 0.156 otherwise. This implies that inflation expectations return to target (or to the mean for the non-IT countries) more slowly than otherwise.[10]

It is important to note that, even under very persistently low inflation, inflation expectations in IT countries remain better anchored than those in the control group. This is not only reflected in a larger estimated coefficient on lagged inflation, but also in the fact that the econometric models explain much more of the variance in inflation expectations (as measured by R^2) for the control group than for the IT countries.

Panels (B) and (C) of Table 4 contain the results of two robustness tests. The first one drops the country fixed effects, and shows that even if the magnitude of the coefficients changes

[10] These results do not depend on Switzerland or the euro area (which have an asymmetric definition of price stability), nor on Japan; dropping these countries from the sample does not affect results—in this case, the estimate of β_1 is 0.149*** and the estimate of β_3 is 0.192***.

somewhat, the results remain qualitatively unchanged. The second robustness test excludes all observations where policy rates are close to the ZLB. The goal of this test is to see whether the previous result is driven by the ZLB observations—if policy rates get close to zero, the central bank might be perceived as having less-powerful tools to bring inflation back to target, resulting in inflation expectations being relatively more backward-looking. This seems to be partially the case—if observations where policy rates are smaller than or equal to 50 basis points are dropped, there is no evidence that expectations become more backward-looking in IT countries for low and persistently low inflation; however, if inflation is very persistently low, the previous results remain valid.[11]

While these results point to some degree of disanchoring of inflation expectations, a potential alternative explanation for the findings could be that inflation is effectively more persistent if low,[12] and that inflation expectations simply reflect this pattern. This argument is particularly important because the horizon of inflation expectations that we are studying is relatively short. It could well be that, while inflation expectations at shorter horizons become more backward-looking, those at longer horizons remain well-anchored. Accordingly, it is important to confirm the findings with alternative tests that are less affected by this complication.

Forecaster disagreement

Another way to study the anchoring of inflation expectations is through forecaster disagreement. If expectations were perfectly anchored at target, there should be no disagreement. Hence, less disagreement can be taken as a signal for a better anchoring of inflation expectations. As pointed out in the literature review, this approach has been used in several previous studies.[13]

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[11] Even when dropping observations at the ZLB, there is a sufficient number of observations to warrant econometric testing—for the case of IT countries, we are left with 379/296/253 observations with low/persistently low/very persistently low inflation; for the control group, we are left with 142/118/104 observations, respectively.

[12] This, however, does not seem to be the case in our data. When testing for different persistence conditional on the level of inflation, the differences are not statistically significant.

[13] Capistran and Ramos-Francia (2010); Cecchetti and Hakkio (2010); Crowe (2010); Ehrmann, Eijffinger and Fratzscher (2012); Siklos (2013).

To study disagreement, we need to define a corresponding metric. Much of the literature (e.g., Dovern, Fritsche and Slacalek (2012) or Mankiw, Reis and Wolfers (2003)) uses the inter-quartile range of forecasts in a given country and month. The advantage of this measure over the simple standard deviation is that it is insensitive to outliers, which might be important in the analysis of survey data. In this paper, we use the inter-decile range instead, which potentially incorporates a broader range of views while still being robust to outliers (unless one believes that more than 10% of the observations on each side of the distribution are outliers). In a robustness test, we show that results are qualitatively equivalent for the inter-quartile range and the standard deviation.

We use these data in two different ways. First, we test whether forecaster disagreement is smaller in IT countries by running the following regression:

$$\Omega_{c,t}(\pi_{c,t+h1}) = \alpha_c + \alpha_m + \gamma_1 E_{c,t}(\pi_{c,t+h1}) + \gamma_2 IT_{c,t} + \varepsilon_{c,t}, \quad (3)$$

where $\Omega_{c,t}(\pi_{c,t+h1})$ denotes the inter-decile range of the inflation expectations for country c over the forecast horizon $h1$, collected in the Consensus Economics survey conducted in month t. The model, as before, controls for country fixed effects and month fixed effects, and also includes the level of inflation expectations, to allow for the fact that higher inflation tends to be more volatile and therefore might be subject to more disagreement. It is estimated using simple ordinary least squares, allowing for panel-corrected standard errors.

The results are reported in column (1) of Table 5. Consistent with the findings of Capistran and Timmermann (2009), the estimate of γ_1 shows that disagreement is larger when inflation expectations are higher. This suggests that higher inflation rates are more difficult to forecast, a point that has been raised in arguments in favour of low inflation targets. Looking at the coefficient of interest, γ_2, it becomes apparent that forecaster disagreement is significantly lower in IT countries—while the average inter-decile range of the next-calendar-year inflation forecasts is 0.89, it stands at 0.82 in IT countries.

Table 5 here

Another regression analysis splits up the different inflation episodes, which, as previously, is done in separate regressions for IT countries and the control group. The regressions are specified as follows:

$$\Omega_{c,t}(\pi_{c,t+h1}) = \alpha_c + \alpha_m + \gamma_1 E_{c,t}(\pi_{c,t+h1}) + \gamma_3 D^l_{c,t} + \gamma_4 D^h_{c,t} + \varepsilon_{c,t} \quad (4)$$

Columns (2) to (7) in Table 5 show the corresponding results. For IT countries, the cross-sectional dispersion increases both when inflation is low and when it is high, and this increase becomes more pronounced when the inflation episodes become more persistent.[14] This is in contrast to the findings for the control group. While disagreement also rises when inflation is high (and even more so when it is persistently high), dispersion in the control group actually decreases when inflation is low, pointing to an interesting difference between targeters and non-targeters. The existence of a target triggers a non-linearity—when inflation deviates from target, disagreement rises. In the absence of a target, the relationship is linear—the lower inflation is, the more forecasters agree about the future evolution of inflation.

Panels (B) to (F) contain the results of several robustness tests. The first two replace our measure of disagreement, the inter-decile range, with the inter-quartile range and the standard deviation. Naturally, these tests deliver smaller coefficients, but tell qualitatively the same story. Panels (D), (E) and (F) retain the inter-decile range as a measure of cross-sectional dispersion, but test whether similar results can be obtained for forecasts of 3-month interest rates, 10-year interest rates and real GDP growth, respectively. In line with earlier findings, e.g., Ehrmann, Eijffinger and Fratzscher (2012), we find that IT reduces dispersion for all of the forecasts. In addition, we also confirm the result that disagreement increases when inflation is (persistently) low and (persistently) high in IT countries, whereas forecasters tend to agree more easily when inflation is low in the control group.

[14] Again, these results do not depend on Switzerland, the euro area or Japan; dropping these countries from the sample does not affect results. In this case, the estimate of γ_3 is 0.059** and the estimate of γ_4 is 0.271***.

Responsiveness to the surprise component in CPI releases

A third way to study the anchoring of inflation expectations is to see how responsive they are to the surprise component contained in news releases. Related tests have, for instance, been conducted by Gürkaynak, Levin and Swanson (2010) and Davis (2014).[15] The idea is that, in the presence of well-anchored inflation expectations, incoming news about the current level of inflation should not be important.

Analogous to the previous tests, we estimate the following relationship:

$$R_{c,t}(\pi_{c,t+h*}) = \alpha_c + \alpha_m + \delta_1 S_{c,t-1} + \delta_2 D^l_{c,t} + \delta_3 D^l_{c,t} S_{c,t-1} + \delta_4 D^h_{c,t} + \delta_5 D^h_{c,t} S_{c,t-1} + \varepsilon_{c,t}, \qquad (5)$$

where $S_{c,t-1}$ is the surprise component contained in the CPI release in country c just prior to the survey conducted in month t. The dependent variable is $R_{c,t}(\pi_{c,t+h*})$, which denotes the *revision* in the inflation forecasts compared with the previous month. This test is therefore different from the first set, where we tested whether the *level* of the expectations depends on the level of lagged inflation. In contrast, we are now interested in understanding whether news about actual inflation leads to a revision in forecasts. To construct the revision, we follow the approach proposed by Kilian and Hicks (2013). Revisions for the months of January to September are based on the current-year forecasts ($R_{c,t}(\pi_{c,t+h*}) = E_{c,t}(\pi_{c,t+h0}) - E_{c,t-1}(\pi_{c,t+h0})$); whereas starting in October, the revisions are based on the expectations for the next calendar year ($R_{c,t}(\pi_{c,t+h*}) = E_{c,t}(\pi_{c,t+h1}) - E_{c,t-1}(\pi_{c,t+h1})$).

Since the Bloomberg expectations data for the CPI releases are not available for all countries in the early 1990s, these tests are based on substantially fewer observations than the earlier tests. In particular, for the non-IT group, the number of observations is very low. Table 6 shows the results for all specifications; however, those for the non-IT group should be taken with considerable caution. In this discussion, we therefore concentrate on the

[15] Using a related technique, Galati, Poelhekke and Zhou (2011) find that there was a larger responsiveness in U.S., UK and euro area inflation expectations to news during the global financial crisis. Autrup and Grothe (2014) confirm this for the United States, but not for the euro area.

differences across inflation regimes within the IT group, rather than study the differences between IT countries and the control group.

Table 6 here

Following the previous results, it is not surprising that δ_1 is positive, i.e., that inflation expectations are responsive to news. What is surprising, however, is that under (persistently) low inflation, the responsiveness seems to be muted, which suggests a *better* anchoring of inflation expectations under these circumstances (whereas, so far, we have argued that they are not anchored as well). How can this be rationalized?

Panels (B) and (C) split the analysis into cases where the inflation numbers have been surprising to the upside and those where the surprises were negative, i.e., expectations were for a higher number than was actually released. A striking result emerges—under low inflation, inflation expectations stop responding to positive inflation surprises, but continue to respond to negative inflation surprises ($\delta_1 + \delta_3$ is effectively zero in Panel (B), as can be seen by the respective *p*-values shown in the table, but it is statistically significantly positive in Panel (C)). In other words, if inflation is low and inflation numbers come in *lower* than expected, inflation expectations decrease further. In contrast, if inflation is low and inflation numbers come in *higher* than expected, inflation expectations do not increase.[16] No such asymmetry is observed if inflation is (persistently) high.

To summarize the findings of this section, it appears that under low and persistently low inflation, there is evidence for less-well-anchored inflation expectations: their level is more dependent on lagged inflation; forecasters tend to disagree more; and inflation expectations get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. All of this suggests that central banks, even those with an inflation target, should expect that inflation expectations will return to target (or the historical mean) more slowly in an environment of weak inflation.

[16] Dropping Switzerland, the euro area and Japan does not alter the results. The coefficients for δ_3 in panels (A), (B) and (C) change to -0.150**, -0.503* and -0.249*, respectively.

6. Implications for policy rates

While there is evidence that inflation expectations are not anchored as well under (persistently) low inflation, the findings so far also suggest that they are considerably better anchored in IT regimes than in the control group. Accordingly, we would suspect that inflation expectations remain closer to target in the IT countries, whereas they move further away from the historical average and take longer to return back to it in the control group. If this were the case, there would be immediate consequences for policy-makers. With inflation expectations anchored at target, policy rates need to react less to changes in inflation. Such a finding would be consistent with the prediction of a simple Taylor-rule model—if the central bank threatens to be more aggressive on inflation, it will have to move policy rates by less in equilibrium.

We study this hypothesis in this section in two ways. First, we analyze the central bank reaction function that is implied in the Consensus Economics forecasts. In that survey, participants are asked about their inflation expectations, but they also provide forecasts for real GDP growth and for 3-month interest rates, allowing us to see how these different forecasts are interlinked. Second, we study to what extent policy rates respond to actual inflation in both IT countries and the control group, and whether there are any differences in the likelihood that a central bank is hitting the ZLB.

In the first analysis, we test the perceived central bank reaction function that is implicit in the Consensus Economics forecasts. This approach is similar to recent work by Carvalho and Nechio (2014), Fendel, Frenkel and Rülke (2011), and Hamilton, Pruitt and Borger (2011), who study the interrelation between forecasts of different macroeconomic variables and their consistency with a monetary policy reaction function. In particular, we estimate the following relationship:

$$E_{c,t}(r_{c,t+12}) - E_{c,t-1}(r_{c,t+12-1}) = \alpha_c + \alpha_m + \eta_1 R_{c,t}(\pi_{c,t+h^*}) + \eta_2 D^l_{c,t} + \eta_3 D^l_{c,t} R_{c,t}(\pi_{c,t+h^*}) + \eta_4 D^h_{c,t} + \eta_5 D^h_{c,t} R_{c,t}(\pi_{c,t+h^*}) + \eta_6 R_{c,t}(y_{c,t+h^*}) + \eta_7 D^l_{c,t} R_{c,t}(y_{c,t+h^*}) + \eta_8 D^h_{c,t} R_{c,t}(y_{c,t+h^*}) + \varepsilon_{c,t}, \quad (6)$$

with all notation as before, and r denoting the 3-month interest rate and y the growth rate of real GDP. Equation (6) therefore tests whether and how the change in interest rate

expectations depends on the revision to the inflation forecasts or the revision to the forecast of real GDP growth. In addition, as before, the effects are allowed to differ across low- and high-inflation regimes.

There are several issues to note with this test. First, the 3-month interest rate forecasts gathered by Consensus Economics are for a fixed horizon of either 3 months or 12 months. We use both, starting with the 12-month horizon and checking robustness using the 3-month horizon. The interest rate forecasts therefore have a different horizon than those provided for inflation and GDP growth. Second, the dependent variable in equation (6) is not the policy rate (for which no forecasts are made available), but rather a market rate.[17]

Table 7 here

As we can see in Table 7, both η_1 and η_6 are estimated to be statistically significant and positive, suggesting some consistency with a monetary policy reaction function, whereby the central bank raises rates in response to higher inflation and growth expectations. It appears that IT central banks are deemed to be more responsive to both inflation and growth expectations than the non-IT group, which is consistent with the major emphasis that IT central banks put on forecasts. More interestingly, however, η_3 and η_7 are negative for the IT countries, suggesting that, in periods of low inflation, forecasters expect interest rates to move less in tandem with macroeconomic variables. This finding is stable regardless of the forecast horizon, as demonstrated by comparing Panel (A) and Panel (B). Importantly, however, it is not due to the ZLB issue—even when excluding observations where policy rates are smaller than or equal to 0.5%, and therefore close to the ZLB, the same result is obtained (Panel (C)). As such, this finding does not seem to reflect a concern that the central bank is not able to move policy rates; rather, it suggests that there are

[17] For both reasons, equation (6) does not need to resemble a Taylor rule. The Taylor rule is often specified as $p_t = \pi_t + r^* + \alpha_\pi(\pi_t - \pi^*) + \alpha_y(y_t - y_t^*)$, where p_t denotes the policy rate, r^* is the assumed equilibrium real interest rate, π^* the inflation target and y_t^* potential output. First-differencing this (and assuming potential output remains constant) yields $\Delta r_t = (1 + \alpha_\pi)\Delta\pi_t + \alpha_y\Delta y_t$. In that case, an estimated coefficient on $\Delta\pi_t$ should be larger than one. Estimating $p_{c,t} = \alpha_c + \alpha_m + \alpha_\pi E_{c,t}(\pi_{c,t+h1}) + \alpha_y E_{c,t}(y_{c,t+h1}) + \varepsilon_{c,t}$ for the IT countries yields α_π=1.348*** and α_y=0.294***, i.e., coefficients that are remarkably close to those proposed in Taylor (1993).

perceptions that the central bank is less concerned about inflation developments when inflation is low, and therefore less willing to move policy rates.

Let us now test the hypothesis that, with inflation expectations anchored at target, policy rates need to react less to the developments in inflation. This is done in two simple ways, the results for which are provided in Table 8. First, we simply calculate the contemporaneous correlation coefficient between policy rates and inflation. Second, we run the following regression:

$$p_{c,t} = \alpha + \kappa_1 \pi_{c,t} + \varepsilon_{c,t}, \quad (7)$$

where $p_{c,t}$ denotes policy rates. While equation (7) does not contain country fixed effects, adding them does not change the results qualitatively.

Table 8 here

While the correlation differs somewhat across inflation regimes, these differences are not statistically significant. However, both the correlation coefficient and the regression coefficient are considerably smaller for IT countries than for the control group. This is entirely plausible—given that inflation expectations are better anchored in IT countries, policy rates need to move less over time.[18]

If policy rates co-move less with inflation under IT, this would also imply that when inflation is low, an IT central bank needs to lower policy rates by less than its non-IT counterpart. As a consequence, it should be less likely to hit the ZLB. This hypothesis is tested in column (3) of Table 8, where we simply report the share of observations where policy rates are below or at 50 basis points. Conditional on inflation being low, the IT central banks are at the ZLB in 24% of all observations, whereas this is the case for the control group in 56% of all observations, a difference of 32 percentage points. This gap remains similar in magnitude if inflation is persistently low, or very persistently so—and

[18] The result does not arise because inflation is spread over a larger range in the non-IT countries. Restricting the analysis to inflation rates between -1% and 6% for both groups does not alter the result qualitatively. Also, dropping Switzerland, the euro area and Japan does not alter the results. The correlation coefficients under very persistently low inflation change to 0.182 for the IT group and to 0.727 for the control group, the regression coefficients to 0.494*** and 2.628***, respectively.

equivalent results are obtained when the ZLB is defined more broadly as policy rates at or below 100 basis points.[19] More formal evidence based on probit models (not shown here for brevity) also confirms the results, and shows that the difference is highly statistically significant.

These results confirm the importance of well-anchored inflation expectations also in periods of weak inflation—having inflation expectations that remain closer to target and return to target more quickly reduces the need for central banks to adjust their policy rates, and therefore makes them less likely to encounter the ZLB.

7. Conclusions

Inflation targeting had originally been introduced to lower and stabilize inflation, and to anchor inflation expectations. Some central banks have only recently started to target inflation (or provide a quantitative definition of their inflation objective) while in a situation of weak inflation. At the same time, a number of IT central banks have been confronted with an environment where inflation has been below target for considerable amounts of time. Therefore, IT is now charged with targeting inflation from below, as opposed to its traditional focus of targeting inflation from above.

Until recently, there have simply not been sufficient data to provide empirical evidence about the environment that central banks can expect when they are targeting inflation from below. This paper has attempted to provide some initial evidence in this direction, focusing on the behaviour of inflation expectations. Using Consensus Economics inflation forecasts for 15 countries over nearly 25 years, the paper has demonstrated that under weak, and especially under persistently weak, inflation, expectations are not as well anchored as otherwise. They tend to become more backward-looking; disagreement across

[19] Also here, results are robust when Switzerland, the euro area and Japan are dropped. Conditional on inflation being very persistently low, the IT central banks are at the ZLB in 5% of all observations, whereas this is the case for the control group in 21% of all observations. One interpretation of these results could be that IT central banks are more hesitant to lower policy rates down to the ZLB. It seems implausible, however, to argue that there should be a systematic difference in that regard between IT central banks and non-targeters.

forecasters increases; and they get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. This evidence implies that in an environment of weak inflation, inflation expectations should not be expected to return to target as quickly as otherwise.

The paper has also provided a comparison of inflation targeters with a control group of non-inflation targeters. Such comparisons are inherently difficult, for reasons that have been discussed widely in the literature. While the central banks in the control group sample have delivered similar inflation outcomes, inflation in the control group has been more volatile than in the IT group, and there are relatively fewer observations for the control group in the later parts of the sample. These caveats need to be considered when interpreting the various results of the comparisons. When comparing IT central banks with those in the control group, the paper has shown that inflation expectations in IT countries are substantially better anchored. This turns out to be an important benefit of having an inflation target, since it implies that policy rates need to react less to actual changes in inflation. Indeed, the paper has shown that policy rates in IT countries are co-moving less with inflation than in the control group. Accordingly, even if inflation is weak, and has been so persistently, IT central banks are considerably less likely to hit the ZLB.

With these findings, we hope to have provided some insights into the inflation-expectation environment that central banks face when targeting inflation from below. While it does not inform the debate on the optimal level of the inflation target, it clearly demonstrates the importance of pinning down inflation expectations by providing a quantitative anchor.

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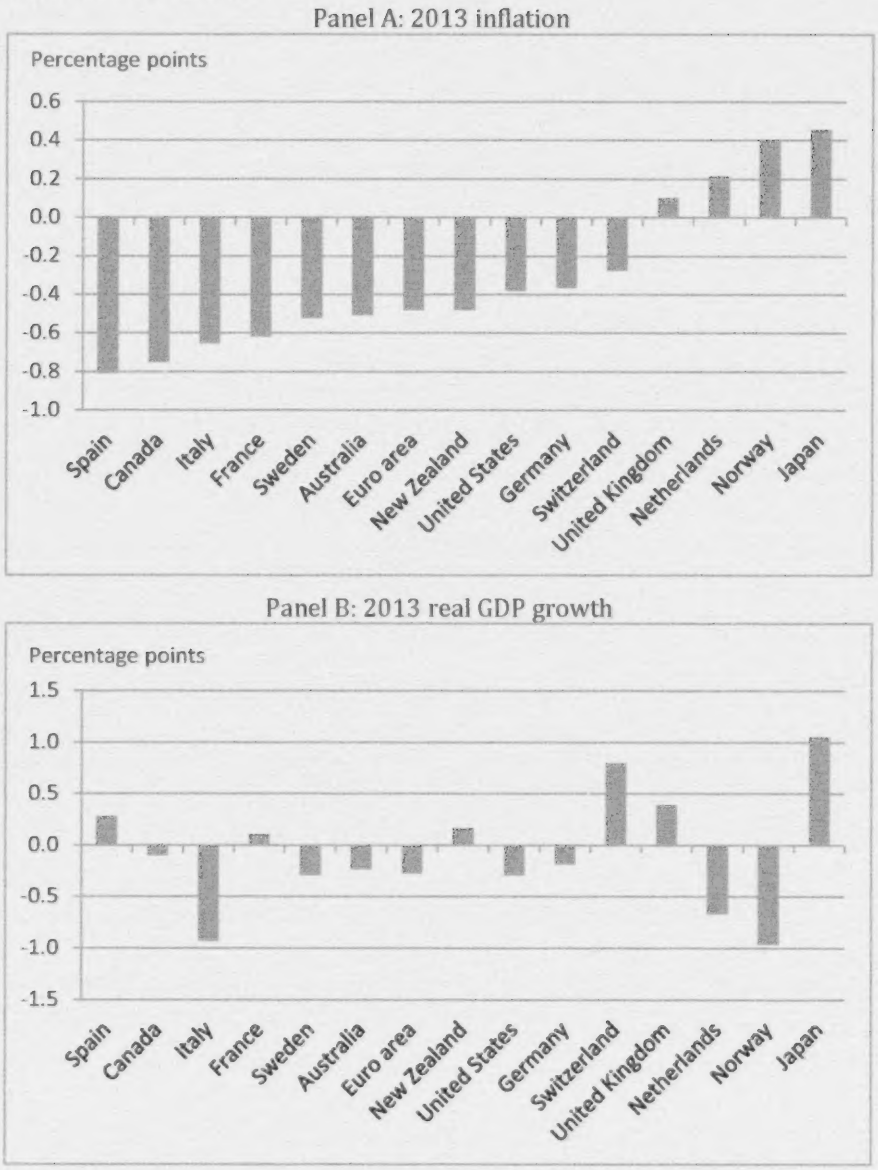
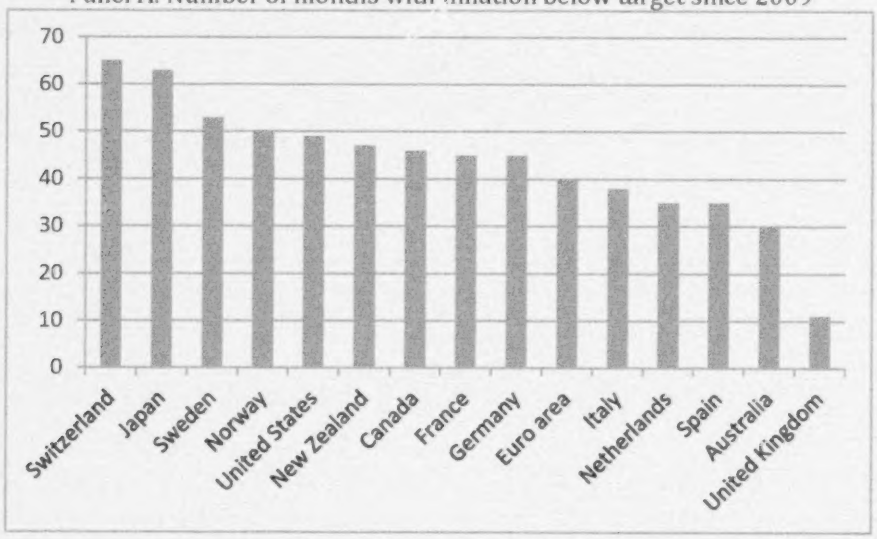
Figure 1: 2013 forecast revisions



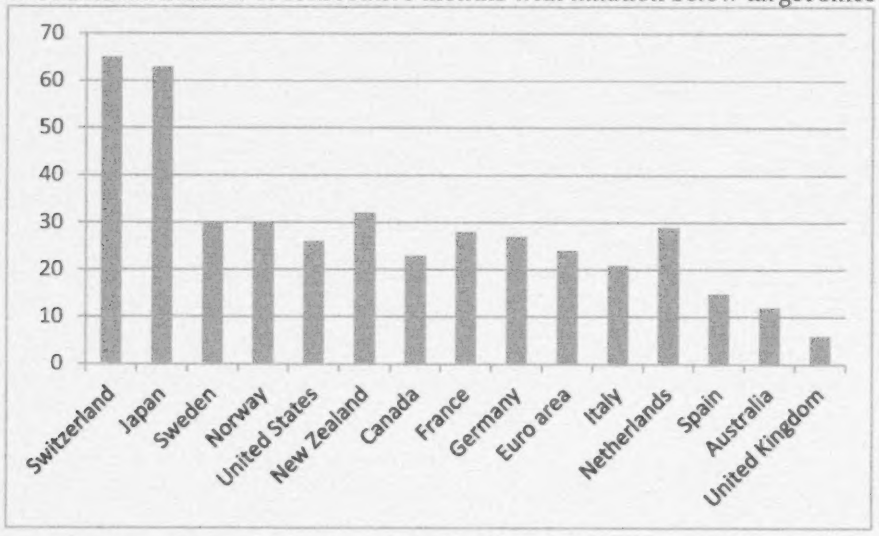
Note: The charts show the revisions to the mean Consensus Economics forecasts for 2013 inflation (Panel A) and 2013 real GDP growth (Panel B) between the forecasts conducted in January 2013 and December 2013.

Figure 2: Weak inflation in advanced economies

Panel A: Number of months with inflation below target since 2009

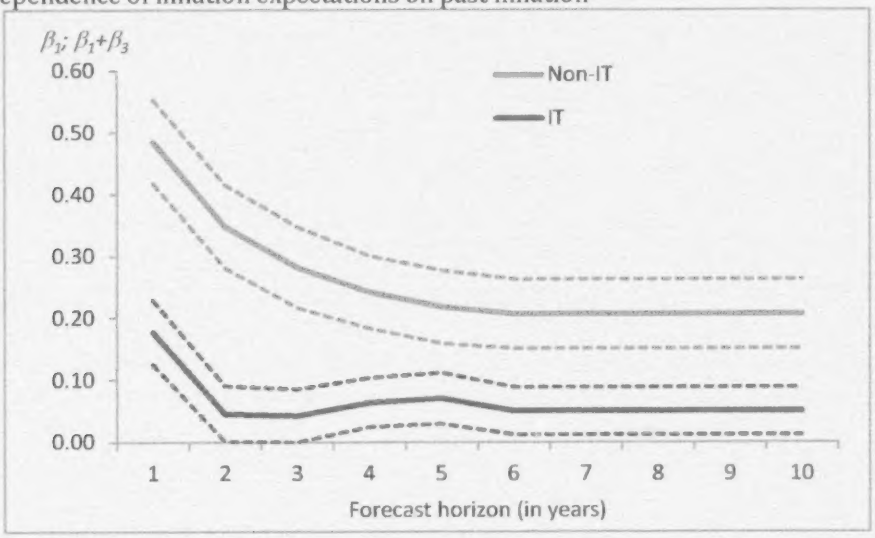


Panel B: Maximum number of consecutive months with inflation below target since 2009



Note: The charts show the number of months with inflation below target since 2009 (Panel A) and the maximum number of consecutive months with inflation below target since 2009 (Panel B), by country.

Figure 3: Dependence of inflation expectations on past inflation



Notes: The chart shows the results of the regression $E_{c,t}(\pi_{c,t+h}) = \alpha_c + \alpha_m + \beta_1 \pi_{c,t-1} + \beta_2 IT_{c,t} + \beta_3 IT_{c,t} \pi_{c,t-1} + \varepsilon_{c,t}$, where $E_{c,t}(\pi_{c,t+h})$ denotes the mean inflation expectations for country c over the forecast horizon h, collected in the Consensus Economics survey conducted in month t. α_c and α_m are country and month fixed effects, and $IT_{c,t}$ is a dummy variable for inflation targeters. The chart shows β_1 ("non-IT") and $\beta_1 + \beta_3$ ("IT"), together with two standard-deviation error bands.

Table 1: Coverage of the data set

Country	Sample			Number of forecasters			IT:
	Start date: mean forecasts	Start date: individual data	End date	Average	Minimum	Maximum	Start date
Australia	1990m1	1990m11	2014m5	17	12	21	1993m3
Canada	1990m1	1990m1	2014m5	15	11	20	1991m2
Euro area	2002m12	2002m12	2014m5	29	22	34	1999m1
France	1990m1	1990m1	1998m12	17	12	21	–
Germany	1990m1	1990m1	1998m12	26	20	31	–
Italy	1990m1	1990m1	1998m12	12	6	15	–
Japan	1990m1	1990m1	2014m5	40	24	52	2012m2
Netherlands	1990m1	1995m1	1998m12	9	7	13	–
New Zealand	1990m1	1994m12	2014m5	13	8	17	1990m3
Norway	1990m1	1998m6	2014m5	9	6	12	2001m3
Spain	1990m1	1995m1	1998m12	13	7	15	1994m11
Sweden	1990m1	1995m1	2014m5	14	7	18	1993m1
Switzerland	1990m1	1998m6	2014m5	13	6	17	2000m1
United Kingdom	1990m1	1990m1	2014m5	28	19	36	1992m10
United States	1990m1	1990m1	2014m5	26	19	33	2012m1

Note: The table provides an overview of the coverage of the Consensus Economics forecast data set and the classification of inflation-targeting regimes.

Table 2: Summary statistics, inflation

	Obs	Mean	St. dev.	Min	Max	AR(1)
All	3099	2.035	1.669	-2.524	12.556	0.956
IT	1822	1.885	1.250	-1.834	6.125	0.933
Non-IT	1277	2.249	2.110	-2.524	12.556	0.955

Note: The table shows summary statistics for CPI inflation, for the full sample (All), for inflation-targeting countries (IT) and countries that are not inflation targeting (Non-IT).

Table 3: Summary statistics, inflation expectations

		Obs	Mean	St. dev.	Min	Max
Current calendar year	All	3099	2.219	1.523	-1.294	10.220
	IT	1822	2.028	1.075	-0.640	5.335
	Non-IT	1277	2.492	1.963	-1.294	10.220
Next calendar year	All	3099	2.264	1.150	-1.023	9.350
	IT	1822	2.132	0.744	-0.178	5.050
	Non-IT	1277	2.453	1.534	-1.023	9.350

Note: The table shows summary statistics for inflation expectations, for the full sample (All), for inflation-targeting countries (IT) and countries that are not inflation targeting (Non-IT).

Table 4: Dependence of inflation expectations on past inflation

	All		Low / high inflation		Persistently low / high inflation		Very persistently low / high inflation	
	IT	Non-IT	IT	Non-IT	IT	Non-IT	IT	Non-IT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(A) Benchmark: full sample, with country fixed effects								
Lagged inflation (β_1)	0.196***	0.448***	0.212***	0.427***	0.190***	0.367***	0.156***	0.301***
	(0.010)	*(0.012)*	*(0.027)*	*(0.044)*	*(0.019)*	*(0.037)*	*(0.015)*	*(0.034)*
Low inflation (β_2)	--	--	0.001	-0.107	-0.036	-0.224***	-0.149***	-0.380***
			(0.061)	*(0.094)*	*(0.048)*	*(0.083)*	*(0.043)*	*(0.077)*
Interaction lagged inflation / low inflation (β_3)	--	--	0.047	0.220***	0.064*	0.273***	0.184***	0.327***
			(0.040)	*(0.066)*	*(0.038)*	*(0.063)*	*(0.040)*	*(0.062)*
High inflation (β_4)	--	--	-0.186	0.191	-0.081	0.172	-0.012	0.133
			(0.171)	*(0.151)*	*(0.197)*	*(0.147)*	*(0.206)*	*(0.147)*
Interaction lagged inflation / high inflation (β_5)	--	--	0.028	-0.023	0.018	0.025	0.027	0.081*
			(0.048)	*(0.052)*	*(0.050)*	*(0.046)*	*(0.051)*	*(0.045)*
p-value ($\beta_1+\beta_3$)	--	--	0.000	0.000	0.000	0.000	0.000	0.000
p-value ($\beta_1+\beta_5$)	--	--	0.000	0.000	0.000	0.000	0.000	0.000
Observations	1,822	1,263	1,822	1,263	1,822	1,263	1,822	1,263
R-squared	0.632	0.859	0.633	0.861	0.632	0.862	0.636	0.864
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(B) Robustness: full sample, without country fixed effects								
Lagged inflation (β_1)	0.340***	0.609***	0.462***	0.470***	0.368***	0.432***	0.312***	0.342***
	(0.012)	*(0.013)*	*(0.032)*	*(0.053)*	*(0.024)*	*(0.044)*	*(0.020)*	*(0.043)*
Low inflation (β_2)	--	--	0.172**	-0.765***	0.014	-0.851***	-0.157***	-1.113***
			(0.076)	*(0.117)*	*(0.062)*	*(0.101)*	*(0.057)*	*(0.100)*
Interaction lagged inflation / low inflation (β_3)	--	--	0.080	0.662***	0.162***	0.666***	0.284***	0.671***
			(0.052)	*(0.083)*	*(0.051)*	*(0.082)*	*(0.055)*	*(0.080)*
High inflation (β_4)	--	--	-0.197	0.107	-0.173	0.146	-0.196	0.021
			(0.207)	*(0.170)*	*(0.235)*	*(0.166)*	*(0.252)*	*(0.166)*
Interaction lagged inflation / high inflation (β_5)	--	--	-0.054	0.014	0.004	0.037	0.044	0.118**
			(0.060)	*(0.059)*	*(0.062)*	*(0.051)*	*(0.064)*	*(0.050)*
p-value ($\beta_1+\beta_3$)	--	--	0.000	0.000	0.000	0.000	0.000	0.000
p-value ($\beta_1+\beta_5$)	--	--	0.000	0.000	0.000	0.000	0.000	0.000
Observations	1,822	1,263	1,822	1,263	1,822	1,263	1,822	1,263
R-squared	0.330	0.720	0.353	0.758	0.339	0.760	0.341	0.768
Country fixed effects	No	No	No	No	No	No	No	No
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(C) Robustness: sample without zero lower bound, with country fixed effects								
Lagged inflation (β_1)	0.189***	0.425***	0.203***	0.419***	0.188***	0.358***	0.158***	0.291***
	(0.011)	*(0.013)*	*(0.028)*	*(0.045)*	*(0.019)*	*(0.037)*	*(0.017)*	*(0.034)*
Low inflation (β_2)	--	--	0.029	-0.122	0.011	-0.231**	-0.103*	-0.442***
			(0.067)	*(0.124)*	*(0.055)*	*(0.117)*	*(0.053)*	*(0.113)*
Interaction lagged inflation / low inflation (β_3)	--	--	0.007	0.292**	0.014	0.390***	0.151***	0.519***
			(0.048)	*(0.138)*	*(0.047)*	*(0.149)*	*(0.052)*	*(0.151)*
High inflation (β_4)	--	--	-0.173	0.089	-0.008	0.076	0.117	0.030
			(0.179)	*(0.151)*	*(0.213)*	*(0.146)*	*(0.225)*	*(0.146)*
Interaction lagged inflation / high inflation (β_5)	--	--	0.033	-0.006	0.008	0.043	0.004	0.101**
			(0.050)	*(0.053)*	*(0.053)*	*(0.046)*	*(0.055)*	*(0.045)*
p-value ($\beta_1+\beta_3$)	--	--	0.000	0.000	0.000	0.000	0.000	0.000
p-value ($\beta_1+\beta_5$)	--	--	0.000	0.000	0.000	0.000	0.002	0.000
Observations	1,571	1,037	1,571	1,037	1,571	1,037	1,571	1,037
R-squared	0.555	0.788	0.556	0.790	0.555	0.791	0.559	0.794
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table shows results from the regression $E_{c,t}(\pi_{c,t+h}) = \alpha_c + \alpha_m + \beta_1\pi_{c,t-1} + \beta_2 D^l_{c,t} + \beta_3 D^l_{c,t}\pi_{c,t-1} + \beta_4 D^h_{c,t} + \beta_5 D^h_{c,t}\pi_{c,t-1} + \varepsilon_{c,t}$, where $D^l_{c,t}$ is a dummy variable for times of (persistently) low inflation, and $D^h_{c,t}$ is a dummy variable for periods when inflation is (persistently) high. Columns (1) and (2) give numbers for the full sample of inflation targeters and non-targeters. Columns (3) and (4) include dummy variables for periods of low/high inflation (defined as inflation below 1%/above 3% for the control group, and 1 percentage point below/above target for IT countries), Columns (5) and (6) include dummy variables for periods of persistently low/high inflation (defined as periods when inflation has been low/high for at least 6 consecutive months), and Columns (7) and (8) include dummy variables for periods of very persistently low/high inflation (defined as periods when inflation has been low/high for at least 9 consecutive months). Panel (A) reports the benchmark results. Panel (B) shows results for a model without country fixed effects, Panel (C) for a model that excludes periods when policy rates are close to the ZLB, defined here as policy rates smaller than or equal to 50 basis points. ***/**/* denote statistical significance at the 1%/5%/10% level. Numbers in brackets are standard errors.

Table 5: Cross-forecaster dispersion

	All	Low / high inflation		Persistently low / high inflation		Very persistently low / high inflation	
		IT	Non-IT	IT	Non-IT	IT	Non-IT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) Benchmark: inter-decile range, next-calendar-year inflation expectations							
Inflation expectations (γ_1)	0.146***	0.225 **	0.071***	0.221***	0.058***	0.223***	0.057***
	(0.010)	*(0.020)*	*(0.015)*	*(0.020)*	*(0.015)*	*(0.020)*	*(0.015)*
IT (γ_2)	-0.072**	--	--	--	--	--	--
	(0.032)						
Low inflation (γ_3)	--	0.033	-0.022	0.045*	-0.066*	0.099***	-0.077**
		(0.022)	*(0.034)*	*(0.023)*	*(0.037)*	*(0.024)*	*(0.037)*
High inflation (γ_4)	--	0.153***	0.086***	0.215***	0.117***	0.262***	0.118***
		(0.030)	*(0.032)*	*(0.035)*	*(0.034)*	*(0.037)*	*(0.035)*
Observations	2,864	1,822	1,042	1,822	1,042	1,822	1,042
R-squared	0.260	0.237	0.469	0.244	0.473	0.256	0.473
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(B) Robustness: inter-quartile range, next-calendar-year inflation expectations							
Inflation expectations (γ_1)	0.062***	0.083***	0.031***	0.081***	0.025***	0.083***	0.024***
	(0.006)	*(0.012)*	*(0.009)*	*(0.011)*	*(0.009)*	*(0.011)*	*(0.009)*
IT (γ_2)	-0.052***	--	--	--	--	--	--
	(0.019)						
Low inflation (γ_3)	--	0.017	-0.017	0.021	-0.037*	0.047***	-0.053**
		(0.013)	*(0.020)*	*(0.014)*	*(0.022)*	*(0.014)*	*(0.022)*
High inflation (γ_4)	--	0.065***	0.028	0.094***	0.043**	0.113***	0.039*
		(0.017)	*(0.020)*	*(0.020)*	*(0.021)*	*(0.021)*	*(0.022)*
Observations	2,864	1,822	1,042	1,822	1,042	1,822	1,042
R-squared	0.213	0.173	0.431	0.179	0.434	0.186	0.435
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(C) Robustness: standard deviation, next-calendar-year inflation expectations							
Inflation expectations (γ_1)	0.058***	0.077***	0.032***	0.078***	0.028***	0.078***	0.026***
	(0.004)	*(0.008)*	*(0.005)*	*(0.008)*	*(0.005)*	*(0.008)*	*(0.005)*
IT (γ_2)	-0.033***	--	--	--	--	--	--
	(0.012)						
Low inflation (γ_3)	--	0.012	-0.000	0.021**	-0.013	0.041***	-0.021
		(0.009)	*(0.012)*	*(0.009)*	*(0.013)*	*(0.009)*	*(0.013)*
High inflation (γ_4)	--	0.065***	0.035***	0.085***	0.046***	0.103***	0.047***
		(0.012)	*(0.011)*	*(0.014)*	*(0.012)*	*(0.015)*	*(0.012)*
Observations	2,864	1,822	1,042	1,822	1,042	1,822	1,042
R-squared	0.298	0.239	0.582	0.246	0.584	0.258	0.585
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5 (continued): Cross-forecaster dispersion

	All	Low / high inflation		Persistently low / high inflation		Very persistently low / high inflation	
		IT	Non-IT	IT	Non-IT	IT	Non-IT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(D) Robustness: inter-decile range, 3-month interest rate expectations 12 months							
Interest rate expectations (γ_1)	0.074***	0.087***	0.033***	0.088***	0.032***	0.089***	0.031***
	(0.006)	*(0.007)*	*(0.012)*	*(0.007)*	*(0.012)*	*(0.007)*	*(0.012)*
IT (γ_2)	-0.368***	--	--	--	--	--	--
	(0.034)						
Low inflation (γ_3)	--	0.067***	-0.131***	0.086***	-0.142***	0.085***	-0.177***
		(0.025)	*(0.039)*	*(0.027)*	*(0.039)*	*(0.028)*	*(0.039)*
High inflation (γ_4)	--	0.130***	-0.012	0.205***	0.014	0.260***	0.024
		(0.033)	*(0.043)*	*(0.038)*	*(0.044)*	*(0.039)*	*(0.045)*
Observations	2,726	1,684	1,042	1,684	1,042	1,684	1,042
R-squared	0.404	0.288	0.582	0.296	0.582	0.302	0.584
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of inflation expectations	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(E) Robustness: inter-decile range, 10-year interest rate expectations 12 months							
Interest rate expectations (γ_1)	0.088***	0.093***	0.069***	0.093***	0.068***	0.094***	0.067***
	(0.005)	*(0.006)*	*(0.015)*	*(0.006)*	*(0.015)*	*(0.006)*	*(0.015)*
IT (γ_2)	-0.105***	--	--	--	--	--	--
	(0.027)						
Low inflation (γ_3)	--	0.057***	-0.043	0.065***	-0.025	0.094***	-0.028
		(0.020)	*(0.032)*	*(0.021)*	*(0.034)*	*(0.022)*	*(0.035)*
High inflation (γ_4)	--	0.073***	0.031	0.105***	0.046	0.151***	0.074**
		(0.025)	*(0.034)*	*(0.028)*	*(0.036)*	*(0.029)*	*(0.036)*
Observations	2,726	1,684	1,042	1,684	1,042	1,684	1,042
R-squared	0.329	0.275	0.417	0.279	0.417	0.287	0.418
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of inflation expectations	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(F) Robustness: inter-decile range, next-calendar-year real GDP growth expectations							
GDP growth expectations (γ_1)	-0.212***	-0.213***	-0.221***	-0.211***	-0.220***	-0.213***	-0.219***
	(0.012)	*(0.015)*	*(0.020)*	*(0.015)*	*(0.020)*	*(0.015)*	*(0.020)*
IT (γ_2)	-0.216***	--	--	--	--	--	--
	(0.034)						
Low inflation (γ_3)	--	0.063***	-0.054	0.108***	-0.080	0.154***	-0.087*
		(0.022)	*(0.046)*	*(0.023)*	*(0.051)*	*(0.025)*	*(0.052)*
High inflation (γ_4)	--	0.031	0.084**	0.080***	0.129***	0.102***	0.150***
		(0.027)	*(0.040)*	*(0.029)*	*(0.042)*	*(0.030)*	*(0.042)*
Observations	2,864	1,822	1,042	1,822	1,042	1,822	1,042
R-squared	0.355	0.249	0.489	0.257	0.492	0.266	0.494
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Level of inflation expectations	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Column (1) shows results from the regression $\Omega_{c,t}(\pi_{c,t+h1}) = \alpha_c + \alpha_m + \gamma_1 E_{c,t}(\pi_{c,t+h1}) + \gamma_2 IT_{c,t} + \varepsilon_{c,t}$, where $\Omega_{c,t}(\pi_{c,t+h1})$ denotes the inter-decile range of the inflation expectations for country c over the forecast horizon $h1$, collected in the Consensus Economics survey conducted in month t. All other variables are as defined in the previous tables. Columns (2) to (7) show results from the regression $\Omega_{c,t}(\pi_{c,t+h1}) = \alpha_c + \alpha_m + \gamma_1 E_{c,t}(\pi_{c,t+h1}) + \gamma_3 D^l_{c,t} + \gamma_4 D^h_{c,t} + \varepsilon_{c,t}$. Columns (2) and (3) include dummy variables for periods of low/high inflation (defined as inflation below 1%/above 3% for the control group, and 1 percentage point below/above target for IT countries), Columns (4) and (5) include dummy variables for periods of persistently low/high inflation (defined as periods when inflation has been low/high for at least 6 consecutive months), and Columns (6) and (7) include dummy variables for periods of very persistently low/high inflation (defined as periods when inflation has been low/high for at least 9 consecutive months). Panel (A) reports the benchmark results. Panel (B) shows results for the inter-quartile range, Panel (C) for the standard deviation. Panels (D) to (F) provide results for the inter-decile range for forecasts of 3-month interest rates, 10-year interest rates and real GDP growth. ***/**/* denote statistical significance at the 1%/5%/10% level. Numbers in brackets are standard errors.

Table 6: Responsiveness of inflation expectations to news surprises about inflation

	All		Low / high inflation		Persistently low / high inflation		Very persistently low / high inflation	
	IT	Non-IT	IT	Non-IT	IT	Non-IT	IT	Non-IT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(A) Benchmark: all news surprises								
News surprise (δ_1)	0.300***	0.225***	0.270***	0.378***	0.291***	0.334***	0.299***	0.315***
	(0.021)	*(0.061)*	*(0.027)*	*(0.095)*	*(0.024)*	*(0.090)*	*(0.023)*	*(0.086)*
Low inflation (δ_2)	--	--	-0.063***	-0.070*	-0.060***	-0.073**	-0.058***	-0.073**
			(0.010)	*(0.037)*	*(0.011)*	*(0.036)*	*(0.011)*	*(0.037)*
Interaction news surprise / low inflation (δ_3)	--	--	-0.048	-0.310***	-0.115**	-0.267**	-0.144***	-0.249**
			(0.048)	*(0.113)*	*(0.052)*	*(0.109)*	*(0.054)*	*(0.106)*
High inflation (δ_4)	--	--	0.016	0.108***	0.021	0.103**	0.016	0.087
			(0.016)	*(0.040)*	*(0.019)*	*(0.048)*	*(0.021)*	*(0.067)*
Interaction news surprise / high inflation (δ_5)	--	--	0.098	-0.211	0.157*	-0.083	0.182*	0.081
			(0.064)	*(0.176)*	*(0.085)*	*(0.209)*	*(0.094)*	*(0.263)*
p-value ($\delta_1 + \delta_3$)	--	--	0.000	0.276	0.000	0.293	0.002	0.294
p-value ($\delta_1 + \delta_5$)	--	--	0.000	0.264	0.000	0.187	0.000	0.112
Observations	1,044	268	1,044	268	1,044	268	1,044	268
R-squared	0.231	0.173	0.262	0.237	0.260	0.226	0.257	0.220
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(B) Robustness: positive news surprises								
News surprise (δ_1)	0.298***	-0.100	0.287***	0.019	0.302***	-0.002	0.307***	0.020
	(0.061)	*(0.106)*	*(0.077)*	*(0.107)*	*(0.065)*	*(0.092)*	*(0.064)*	*(0.089)*
Low inflation (δ_2)	--	--	-0.010	-0.041	0.008	-0.034	0.011	-0.020
			(0.037)	*(0.065)*	*(0.039)*	*(0.064)*	*(0.040)*	*(0.064)*
Interaction news surprise / low inflation (δ_3)	--	--	-0.326*	-0.549*	-0.451**	-0.570*	-0.515**	-0.618**
			(0.186)	*(0.309)*	*(0.198)*	*(0.303)*	*(0.206)*	*(0.299)*
High inflation (δ_4)	--	--	0.032	0.214***	0.010	0.265***	0.010	0.372***
			(0.036)	*(0.064)*	*(0.048)*	*(0.074)*	*(0.056)*	*(0.087)*
Interaction news surprise / high inflation (δ_5)	--	--	0.016	-0.443**	0.120	-0.529**	0.137	-0.724***
			(0.126)	*(0.202)*	*(0.203)*	*(0.250)*	*(0.251)*	*(0.266)*
p-value ($\delta_1 + \delta_3$)	--	--	0.822	0.071	0.433	0.049	0.293	0.037
p-value ($\delta_1 + \delta_5$)	--	--	0.004	0.014	0.029	0.023	0.069	0.005
Observations	355	100	355	100	355	100	355	100
R-squared	0.210	0.288	0.248	0.461	0.247	0.479	0.250	0.507
Country fixed effects	No	No	No	No	No	No	No	No
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(C) Robustness: negative news surprises								
News surprise (δ_1)	0.443***	0.616**	0.450***	0.670	0.491***	0.605	0.501***	0.561
	(0.050)	*(0.300)*	*(0.066)*	*(0.455)*	*(0.058)*	*(0.421)*	*(0.057)*	*(0.431)*
Low inflation (δ_2)	--	--	-0.088***	-0.051	-0.103***	-0.050	-0.115***	-0.047
			(0.025)	*(0.134)*	*(0.025)*	*(0.131)*	*(0.026)*	*(0.131)*
Interaction news surprise / low inflation (δ_3)	--	--	-0.053	-0.032	-0.174*	0.032	-0.229**	0.075
			(0.096)	*(0.623)*	*(0.103)*	*(0.601)*	*(0.106)*	*(0.607)*
High inflation (δ_4)	--	--	0.013	-0.003	0.019	-0.102	-0.006	-0.191
			(0.055)	*(0.215)*	*(0.069)*	*(0.377)*	*(0.074)*	*(0.385)*
Interaction news surprise / high inflation (δ_5)	--	--	0.116	-0.626	0.098	-0.810	0.048	-0.757
			(0.229)	*(1.085)*	*(0.244)*	*(1.812)*	*(0.252)*	*(1.809)*
p-value ($\delta_1 + \delta_3$)	--	--	0.000	0.124	0.000	0.129	0.003	0.128
p-value ($\delta_1 + \delta_5$)	--	--	0.009	0.963	0.013	0.906	0.026	0.910
Observations	421	85	421	85	421	85	421	85
R-squared	0.227	0.309	0.269	0.337	0.263	0.321	0.262	0.318
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table shows results from the regression $R_{c,t}(\pi_{c,t+h*}) = \alpha_c + \alpha_m + \delta_1 S_{c,t-1} + \delta_2 D^l_{c,t} + \delta_3 D^l_{c,t} S_{c,t-1} + \delta_4 D^h_{c,t} + \delta_5 D^h_{c,t} S_{c,t-1} + \varepsilon_{c,t}$, where $R_{c,t}(\pi_{c,t+h*})$ denotes the revision in the inflation forecasts compared with the previous month. $S_{c,t-1}$ is the surprise component contained in the CPI release in country c just prior to the survey conducted in month t. All other variables are as defined in the previous tables. Columns (1) and (2) give numbers for the full sample of inflation targeters and non-targeters. Columns (3) and (4) include dummy variables for periods of low/high inflation (defined as inflation below 1%/above 3% for the control group, and 1 percentage point below/above target for IT countries), Columns (5) and (6) include dummy variables for periods of persistently low/high inflation (defined as periods when inflation has been low/high for at least 6 consecutive months), and Columns (7) and (8) include dummy variables for periods of very persistently low/high inflation (defined as periods when inflation has been low/high for at least 9 consecutive months). Panel (A) reports the benchmark results. Panel (B) shows results for positive news surprises (i.e., CPI inflation data coming in higher than expected), Panel (C) for negative news surprises (i.e., CPI inflation data coming in lower than expected. ***/**/* denote statistical significance at the 1%/5%/10% level. Numbers in brackets are standard errors.

Table 7: Implied monetary policy reaction functions

	All		Low / high inflation		Persistently low / high inflation		Very persistently low / high inflation	
	IT	Non-IT	IT	Non-IT	IT	Non-IT	IT	Non-IT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(A) Benchmark: expected change in 3-month rates, 12 months out								
Low inflation (η_2)	–	–	0.016	0.018	0.029**	0.013	0.019	-0.007
			(0.011)	*(0.020)*	*(0.012)*	*(0.020)*	*(0.012)*	*(0.020)*
High inflation (η_4)	–	–	-0.036**	-0.034	-0.024	-0.042*	-0.032*	-0.048*
			(0.016)	*(0.024)*	*(0.017)*	*(0.026)*	*(0.018)*	*(0.026)*
Revision of inflation expectations (η_1)	0.314***	0.232***	0.361***	0.046	0.357***	0.067	0.359***	0.067
	(0.031)	*(0.067)*	*(0.047)*	*(0.120)*	*(0.043)*	*(0.115)*	*(0.042)*	*(0.113)*
Interaction with low inflation (η_3)	–	–	-0.161**	0.047	-0.184**	0.023	-0.226***	0.010
			(0.078)	*(0.158)*	*(0.081)*	*(0.157)*	*(0.082)*	*(0.157)*
Interaction with high inflation (η_5)	–	–	0.049	0.320**	0.031	0.298**	0.022	0.303**
			(0.076)	*(0.147)*	*(0.075)*	*(0.144)*	*(0.075)*	*(0.142)*
Revision of GDP growth expectations (η_6)	0.478***	0.173***	0.480***	0.456***	0.509***	0.448***	0.521***	0.445***
	(0.023)	*(0.031)*	*(0.033)*	*(0.067)*	*(0.031)*	*(0.064)*	*(0.030)*	*(0.063)*
Interaction with low inflation (η_7)	–	–	-0.193***	-0.425***	-0.266***	-0.422***	-0.336***	-0.414***
			(0.051)	*(0.074)*	*(0.052)*	*(0.072)*	*(0.052)*	*(0.071)*
Interaction with high inflation (η_8)	–	–	0.129**	-0.348***	0.076	-0.349***	0.074	-0.347***
			(0.062)	*(0.096)*	*(0.065)*	*(0.094)*	*(0.066)*	*(0.094)*
Observations	1,795	1,329	1,795	1,329	1,795	1,329	1,795	1,329
R-squared	0.296	0.082	0.319	0.112	0.319	0.112	0.325	0.111
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(B) Robustness: expected change in 3-month rates, 3 months out								
Low inflation (η_2)		–	0.016	0.023	0.024*	0.012	0.017	-0.005
			(0.012)	*(0.020)*	*(0.012)*	*(0.020)*	*(0.013)*	*(0.020)*
High inflation (η_4)	–	–	-0.028	-0.023	-0.012	-0.040	-0.024	-0.046*
			(0.018)	*(0.026)*	*(0.019)*	*(0.027)*	*(0.020)*	*(0.027)*
Revision of inflation expectations (η_1)	0.386***	0.186***	0.442***	-0.099	0.419***	-0.068	0.425***	-0.055
	(0.034)	*(0.070)*	*(0.050)*	*(0.123)*	*(0.045)*	*(0.119)*	*(0.044)*	*(0.116)*
Interaction with low inflation (η_3)	–	–	-0.206**	0.160	-0.220**	0.126	-0.264***	0.090
			(0.083)	*(0.157)*	*(0.087)*	*(0.155)*	*(0.089)*	*(0.153)*
Interaction with high inflation (η_5)	–	–	0.039	0.466***	0.072	0.434***	0.062	0.422***
			(0.083)	*(0.153)*	*(0.084)*	*(0.150)*	*(0.084)*	*(0.148)*
Revision of GDP growth expectations (η_6)	0.469***	0.161***	0.499***	0.428***	0.505***	0.415***	0.515***	0.402***
	(0.025)	*(0.033)*	*(0.036)*	*(0.070)*	*(0.033)*	*(0.067)*	*(0.032)*	*(0.066)*
Interaction with low inflation (η_7)	–	–	-0.282***	-0.410***	-0.322***	-0.402***	-0.388***	-0.376***
			(0.053)	*(0.077)*	*(0.053)*	*(0.074)*	*(0.053)*	*(0.073)*
Interaction with high inflation (η_8)	–	–	0.119*	-0.308***	0.137*	-0.304***	0.124	-0.293***
			(0.070)	*(0.102)*	*(0.074)*	*(0.100)*	*(0.075)*	*(0.100)*
Observations	1,795	1,329	1,795	1,329	1,795	1,329	1,795	1,329
R-squared	0.273	0.068	0.300	0.098	0.301	0.097	0.307	0.095
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(C) Robustness: expected change in 3-month rates, 12 months out, sample without zero lower bound								
Low inflation (η_2)	–	–	0.010	0.010	0.023	0.006	0.013	-0.034
			(0.013)	*(0.031)*	*(0.014)*	*(0.034)*	*(0.015)*	*(0.035)*
High inflation (η_4)	–	–	-0.040**	-0.033	-0.027	-0.042	-0.036*	-0.049*
			(0.017)	*(0.025)*	*(0.019)*	*(0.027)*	*(0.020)*	*(0.027)*
Revision of inflation expectations (η_1)	0.312***	0.244***	0.354***	0.010	0.351***	0.036	0.353***	0.039
	(0.034)	*(0.075)*	*(0.050)*	*(0.145)*	*(0.046)*	*(0.140)*	*(0.044)*	*(0.135)*
Interaction with low inflation (η_3)	–	–	-0.163*	0.041	-0.195**	0.007	-0.242***	-0.090
			(0.087)	*(0.254)*	*(0.092)*	*(0.261)*	*(0.094)*	*(0.284)*
Interaction with high inflation (η_5)	–	–	0.057	0.356**	0.038	0.328**	0.026	0.328**
			(0.081)	*(0.167)*	*(0.080)*	*(0.163)*	*(0.081)*	*(0.159)*
Revision of GDP growth expectations (η_6)	0.536***	0.274***	0.504***	0.503***	0.533***	0.490***	0.541***	0.482***
	(0.026)	*(0.047)*	*(0.036)*	*(0.078)*	*(0.033)*	*(0.074)*	*(0.032)*	*(0.073)*
Interaction with low inflation (η_7)	–	–	-0.126**	-0.317**	-0.205***	-0.308*	-0.293***	-0.231
			(0.063)	*(0.150)*	*(0.067)*	*(0.170)*	*(0.070)*	*(0.177)*
Interaction with high inflation (η_8)	–	–	0.132**	-0.396***	0.084	-0.392***	0.087	-0.385***
			(0.066)	*(0.104)*	*(0.068)*	*(0.102)*	*(0.069)*	*(0.101)*
Observations	1,544	1,103	1,544	1,103	1,544	1,103	1,544	1,103
R-squared	0.316	0.092	0.332	0.113	0.331	0.112	0.336	0.112
Country and month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table shows results from the regression $E_{c,t}(r_{c,t+12}) - E_{c,t-1}(r_{c,t+12-1}) = \alpha_c + \alpha_m + \eta_1 R_{c,t}(\pi_{c,t+h^*}) + \eta_2 D^l_{c,t} + \eta_3 D^l_{c,t} R_{c,t}(\pi_{c,t+h^*}) + \eta_4 D^h_{c,t} + \eta_5 D^h_{c,t} R_{c,t}(\pi_{c,t+h^*}) + \eta_6 R_{c,t}(y_{c,t+h^*}) + \eta_7 D^l_{c,t} R_{c,t}(y_{c,t+h^*}) + \eta_8 D^h_{c,t} R_{c,t}(y_{c,t+h^*}) + \varepsilon_{c,t}$. r denotes the 3-month interest rate and y the growth rate of real GDP. Columns (1) and (2) give numbers for the full sample of inflation targeters and non-targeters. Columns (3) and (4) include only periods of low/high inflation, Columns (5) and (6) periods of persistently low/high inflation, and Columns (7) and (8) periods when inflation is very persistently low/high. Panel (A) reports the benchmark results for the expected change in 3-month interest rates over a forecast horizon of 12 months. Panel (B) shows results for the expected change in 3-month interest rates over a forecast horizon of 3 months, Panel (C) excludes periods when policy rates are close to the ZLB, defined here as policy rates smaller than or equal to 50 basis points. ***/**/* denote statistical significance at the 1%/5%/10% level. Numbers in brackets are standard errors.

Table 8: Inflation and policy rates

		(1)	(2)		(3)	(4)
		ρ(p,π)	Coeff	*Std.error*	Pr(ZLB)	Obs.
Full sample	All	0.651	1.211 ***	*(0.027)*	0.154	2880
	IT	0.425	0.769 ***	*(0.038)*	0.138	1760
	Non-IT	0.782	1.430 ***	*(0.045)*	0.177	1120
Low inflation	All	0.492	1.316 ***	*(0.086)*	0.369	754
	IT	0.346	0.977 ***	*(0.121)*	0.242	486
	Non-IT	0.623	1.491 ***	*(0.116)*	0.564	268
Persistently low inflation	All	0.475	1.312 ***	*(0.101)*	0.418	634
	IT	0.336	0.962 ***	*(0.140)*	0.278	396
	Non-IT	0.554	1.373 ***	*(0.149)*	0.608	238
Very persistently low inflation	All	0.471	1.331 ***	*(0.110)*	0.443	572
	IT	0.333	1.014 ***	*(0.160)*	0.285	340
	Non-IT	0.539	1.212 ***	*(0.140)*	0.638	232

Notes: Column (1) shows the contemporaneous correlation between policy rates and inflation. Column (2) shows the estimates for κ_1 from the regression $p_{c,t} = \alpha + \kappa_1 \pi_{c,t} + \varepsilon_{c,t}$, where $p_{c,t}$ denotes policy rates in country c at time t. All other variables are as defined in the previous tables. ***/**/* denote statistical significance at the 1%/5%/10% level, and numbers in brackets are standard errors. Column (3) shows the share of observations where policy rates are at or near the ZLB (i.e., equal to or less than 50 basis points). Column (4) provides the number of observations that are available for each case. Results are shown for the full sample, for periods of low inflation, for periods of persistently low inflation (when inflation has been low for at least 6 consecutive months) and for periods of very persistently low inflation (when inflation has been low for at least 9 consecutive months).